International Journal of Mechanical and Production Engineering Research and Development (IJMPERD)
ISSN(P): 2249-6890; ISSN(E): 2249-8001
Vol. 9, Issue 3, Jun 2019, 593-600

EVALUATING PERFORMANCE AND EMISSIONS OF CI ENGINE RUN BY BLENDS OF MOSAMBI PEEL METHYL ESTER AND DIESEL FUEL

K. VENKATESAN[1], B. KIRAN KUMAR[2] & P. S. PREMA KUMAR[3]

[1,2]Associate Professor, Department of Mechanical Engineering,

Koneru Lakshmaiah Education Foundation, Vaddeswaram, Guntur, Andhra Pradesh, India

[3]Assistant Professor, Department of Mechanical Engineering,

Koneru Lakshmaiah Education Foundation, Vaddeswaram, Guntur, Andhra Pradesh, India

ABSTRACT

An experimental study is carried out; a mixture of Mosambi peel methyl ester fuels produced from Mosambi peel pyro oil was blended in 10%, 15% and 20 % with Diesel fuel. The Mosambi peel methyl ester and diesel blends were tested in a direct injection mono cylinder natural aspirated diesel engine and its four different loads and 1500 rpm engine speed. It is experiential that the performance results shows that the thermal efficiency with the Mosambi peel methyl ester addition was decreased meant for the all engine loads with the earlier stage combustion timings as a result of more cetane number of Mosambi peel methyl ester fuel. The most heat discharge rate and the in cylinder pressure rise rate were slightly decreased as well as the combustion duration was normally increased with the Mosambi peel methyl ester adding. On the other hand, important altering was not experiential on the maximum in cylinder pressures. In count, it was experimental that the mean effective pressure values be to some extent different depending on the start of combustion timing and the center of heat release position. It is found with the intention of 5 % and 10% Mosambi peel methyl ester fuel adding up resulted in to some extent rise on break specific fuel consumption (increased 5%) as well as decrease on break thermal efficiency (increased 3.5%). Mosambi peel methyl ester added extras also increased NOx emissions cognizant to 9% and decrease smoke with hydrocarbon emissions as well as CO emissions for the entire engine loads. Some reduction was experiential at the full engine load. Also, CO2 emissions were to some extent increased for the each engine loads.

KEYWORDS: Bio Diesel, Mosambi Peel Ester, Diesel Engine, Performance & Gas Emission

Received: Feb 25, 2019; **Accepted:** Mar 15, 2019; **Published:** May 03, 2019; **Paper Id.:** IJMPERDJUN201963

Original Article

1. INTRODUCTION

Biodiesel are methyls which are derived as of a variety selection of renewable sources for instance vegetable oil, animal fat and cooking oil. Even though, during the most recent decade ethanol and bio diesel develop into the best known liquid bio fuels, numerous studies [1,2] observe dissimilar chemical structures while promising bio fuels along with confirmation their pros and cons. Some further types of vegetable oils, sun flower oil, corn oil and olive oil with the intention of many Mediterranean areas, alongside with a few wastes, such as used frying oils, appear to be attractive for biodiesel production [3].Vegetable oil esters be there increasing attention as a non–toxic, biodegradable and renewable alternative diesel fuel. Corrêa et al. (2008) evaluate utilize of sun flower bio diesel blend (B5, B10, B20 and B100) and diesel in an IC engine, direct injection analyze the performance of engine used for each fuel. Barbosa et al. (2008) studied the possibility of with diesel oil and mineral mixtures with the quantity of biodiesel equal. They reported that the increased engine power the B100 to

mineral diesel, on the other hand, the thermal efficiency of the diesel decreased mineral mixtures for rising biodiesel, and 4% lesser for B100. Various studies contain shown that the properties of biodiesel are very secure next to those of diesel fuel. A bio diesel has a superior cetane number than petroleum diesel fuel, no aromatics, and contains 12% to 14% oxygen by weight. The above individuality of bio diesel is decrease the emissions of carbon monoxide, hydrocarbons, and particulate matter in the exhaust gas compare with diesel fuel.

2. PREPARATION OF BIO DIESEL BLENDS

Bio oil can be prepared by mixing the Mosambi peel methyl ether (MPME) with and diesel fuel. For preparing them D90MPME10 (10%MPME+90D), D85MPME15 (15%MPME+85%D) and D80MPME20 (20% MPME + 80% D) were taken in a container. The mixture was stirred vigorously until a homogenous mixture was formed. The stirrer speed was maintained as 850 rpm. Stable oil preparation was obtained by stirring the mixture for 20 to 25 minutes and the stability of the homogeneous mixture was found as stable for five months. The blending of oil was mixed with the facilitate of a mechanical stirrer, as well as it is found that up to 20% of MPME bio oil with blends easily with diesel fuels, without any separation for a long time. D90MPME10, D85MPME15 and D80MPME20 blends of Mosambi peel methyl ester and diesel fuel have low viscosity, density, flash point, fire point, and calorific value while compared near diesel fuel. All bio oil properties of blend are closed to that of diesel fuel.

2.1. MPPO Bio Fuel FT-IR Analysis

The diagram which shows the variation of the proportion of transmittance with wave number be called infrared spectrum. The range 100 % transmittance means 0 % absorption and vice versa. Atoms molecule be capable of make stretching vibration in addition to bending vibration in the sample of mosambi peel pyro oil and the spectra collects all the information at the same time with the hold up of Fourier transform programme converts it into frequency domain spectrum. The direct structural examination of sample within seconds is probable with the aid of FTIR spectroscopy as given in the figure 1. The C-H stretching vibration 2920.12 cm^{-1} and 2855.34 cm^{-1} indicates the presence of Alkane compounds. The C-H stretching 1711.02 cm^{-1} indicate the presence of Alkenes and Alkynes strong C-H stretching. 1457.54 cm^{-1} indicate the carboxylic acids functional group. FTIR analysis shows that the Mosambi peel pyro oil contains more number of HC present in the fuel which is helpful for combustion.

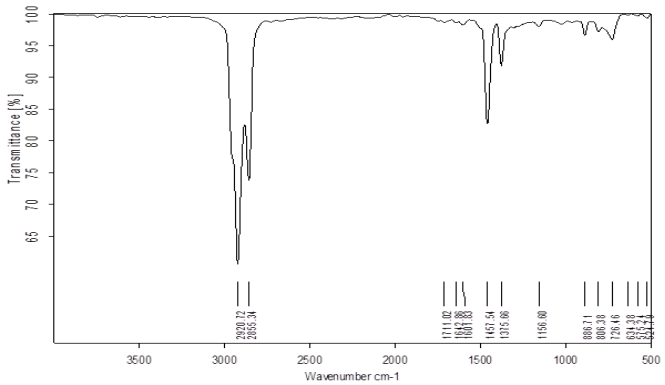

Figure 1: Mosambi Peel Pyro Oil FTIR Analysis

Table 1 show that Properties of different fuels of all blends of bio oil related to diesel fuel. All properties of blends show that they are concerning to diesel fuel. Blends of D90MPME10, D85MPME15 and D80MPME20 show that viscosities of 3.55, 3.67 and 3.72 Cst respectively.

Table 1: Properties of Different Bio Fuel Blends

Properties	Diesel	D90MPME10	D85MPME15	D80MPME20
Density (kg/m3)	842	848	856	860
Flash Point (C)	50	52	55	58
Fire Point (C)	55	57	59	61
Calorific Value (MJ/kg)	43.5	41.65	40.10	39.89
Viscosity (cst)@40C	3.4	3.55	3.67	3.72
Water Content (%)	0	0.15	0.20	0.23

2.2. Experimental Procedure

A single cylinder, open chamber, direct injection, water cooled, four stroke diesel engine with a displacement volume of 630CC, compression ratio of 16:1, developing a rated power output of 3.7kW at 1500 rev/min was used for this work. The Engine specifications are provided below within the Table 2. The Exhaust gas temperature is recorded with the help of k-type thermocouples. Electric dynamometer was used to record the output power. With the help of the burette and stop clock the fuel consumption time was noted. Brake mean effective pressure 1 bars, 2 bars and 3 bars are load of the test Diesel engine.

Table 2: Engine Set Up Specifications

Type	4S, CI, Water cooled, Single cylinder diesel engine
Capacity	630 CC
Bore × stroke	80mm × 110 mm
Compression Ratio	16:1
Speed	1500 RPM
Rated power	3.5 kW
Injection Timing	27° Before Top Dead Centre
Injection Pressure	200 bar

Figure 2: Photographic View of the Experimental Engine Set Up

3. RESULTS AND DISCUSSIONS

3.1. Performance Characteristics

The figure 3 shows that the variation of brake thermal efficiency of diesel, D90MPME10, D85MPME15 and D80MPME20 fuel. There is a slightly reduced in the D90MPME10 when compared to diesel. However, there is significantly reduced in the thermal efficiency in D90MPME10 with diesel blends. Mosambi peel methyl ester has a heating value lesser than diesel, which result in small peak cycle temperature. D85MPME15 and D80MPME20 fuel show reduced peak cycle temperature compare to diesel. The usage of blended Mosambi peel methyl ester was mainly due to the high viscosity, density and reduced energy content.

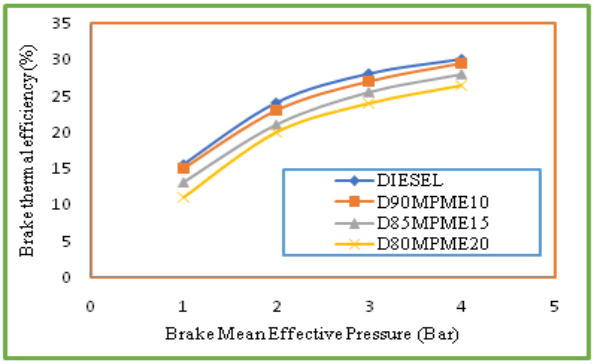

Figure 3: Brake Mean Effective Pressure vs Brake Thermal Efficiency

Figure 4 shows the variation of Brake specific fuel consumption with Brake Mean Effective pressure used for diesel fuel, D90MPME10, D85MPME15 and D80MPME20.The trends show that the performance of all blends is quite similar to diesel fuel. D90MPME10 a blend of Mosambi peel methyl ester oil have the inferior BSFC compared to other D85MPME15 and D80MPME20 blends, mainly because of higher energy content of the Mosambi peel methyl ester with diesel fuel blends. On rated load, BSFC of D90MPME10 is higher compare to diesel fuel. This fact was observed due to slightly higher viscosity and density fuel blends.

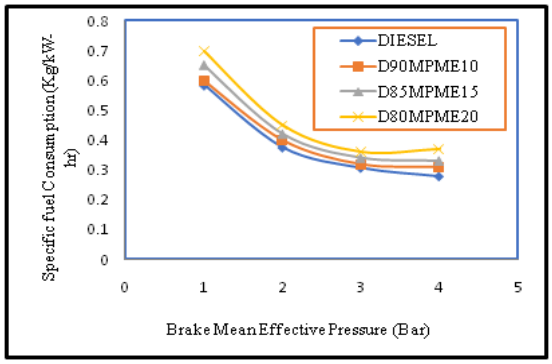

Figure 4: Brake Mean Effective Pressure vs Specific Fuel Consumption

3.2. Emission Characteristics

Figure 5 indicate the variation of HC emission by means of Brake Mean Effective Pressure for Mosambi peel Methyl ester is due to better combustion of D90MPME10, D85MPME15 and D80MPME20. Additions of Mosambi peel methyl ester in the blend enhance the better combustion and therefore HC emission is reduced.

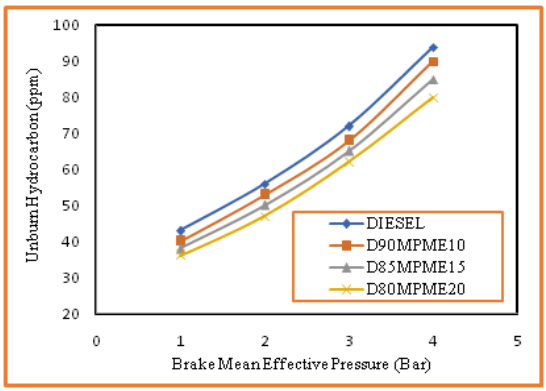

Figure 5: Brake Mean Effective Pressure vs Un-Burned Hydro Carbon

The indicate result of CO emission with pressure is shown figure 6. It is experiential that CO emission increase with the load. D90MPME10, D85MPME15 and D80MPME20 produce lesser CO emission while compare toward diesel. In order toward reduce CO emission further methyl ester methyl ester is blended with diesel fuel where there is drastic reduction in CO level as compared to diesel. Combustion through D90MPME10, D85MPME15 and D80MPME20 consequences in reduced HC and CO emission appropriate to high cetane number and Oxygen condense of blends.

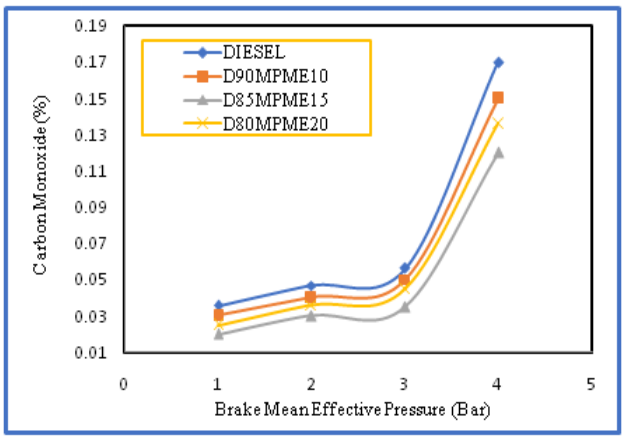

Figure 6: Brake Mean Effective Pressure vs Carbon Monoxide

Mosambi methyl oil blends with diesel resulted in considerable reduction in NOx emissions as compared to BD at all power outputs as shown in Figure 7. D90MPME10, D85MPME15 and D80MPME20 have higher NOx emission compare to diesel fuel. Slow burning rate of NOx which is very sensitive to maximum temperature of all blended fuels which has relatively due to the increased the peak cycle temperature and more Cetane number of fuel blends. The variation of Smoke emission with Brake Mean effective Pressure for Mosambi methyl ester can be seen in Figure 8. All D90MPME10, D85MPME15 and D80MPME20 blended experience lower smoke emissions as compare to diesel fuel, appropriate close to its viscous nature which results in better atomization and thus paves way for reduced premixed combustion and prolonged diffusion combustion. This effect is due to complete combustion which leads to all blended fuel.

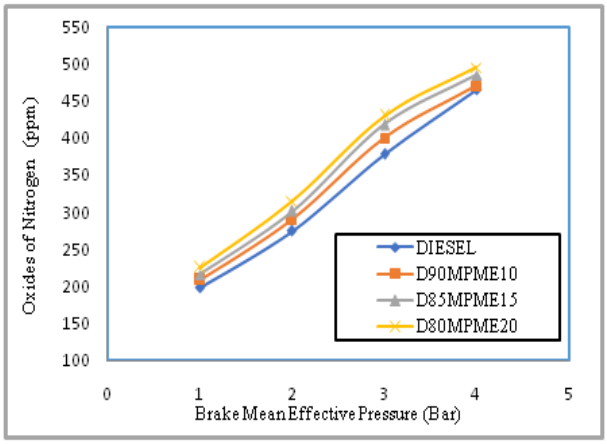

Figure 7: Brake Mean Effective Pressure vs Oxide of Nitrogen

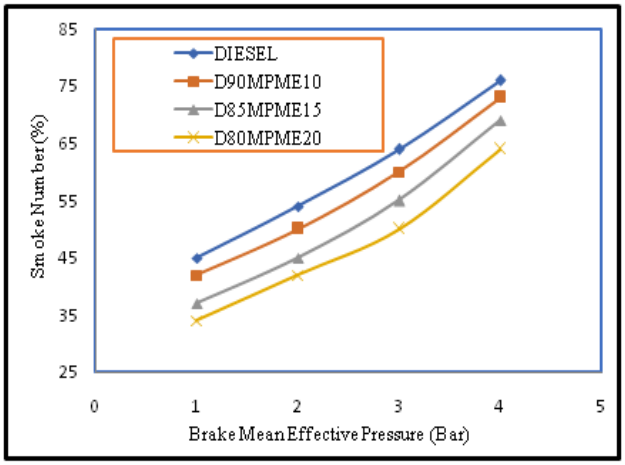

Figure 8: Brake Mean Effective Pressure vs Smoke Number

4. CONCLUSIONS

Experiential that the engine is capable to run on 20% of Mosambi methyl ester oil 80% of diesel fuel. Engine ineffective to run properly with above 20 % of Mosambi methyl ester oil blends. Brake Thermal Efficiency increase with raise in percentage of blend, but D90MPME10 show slightly lower level than to diesel. Specific fuel energy consumption gradually reduced with increasing load. A D90MPME10, D85MPME15 and D80MPME20 blends show higher level than that of diesel fuel. HC emissions are D80MPME20 emission is very low at fuel load compare to diesel fuel. CO emission is minor than that of diesel. This may be because of high Cetane number and high calorific value of fuel. NOx is higher by about 7.5 % for D90MPME10, 8% for D85MPME15 and 9.0% for D80MPME20 full load operation so as to diesel fuel. Smoke opacity of D90MPME10, D85MPME15 and D80MPME20 are significant reduction of diesel fuel.

REFERENCES

1. *Pecci GC, Clerici MG, Giavazzi F, Ancillotti F, Marchionna M, Patrini R. Oxygenated diesel fuels, part 1—structure and properties correlation. Proceedings of the Ninth International Symposium on Alcohol Fuels (ISAF), Firenze, 1991. P.321–326.*
2. *Bailey B, Eberhardt J, Goguen S, Erwin J. Diethyl ether (DEE) as a renewable diesel fuel. SAE Paper No. 972978, SAE, Warrendale, PA, 1997.*
3. *Ayoola, A. A., Anawe, P. A. L., Ojewumi, M. E., & Amaraibi, R. J. (2016). Comparison Of The Properties Of Palm Oil And Palm Kerneloil Biodiesel In Relation To The Degree Of Unsaturation Of Their Oil Feedstocks. International Journal of Applied and Natural Sciences, 5(3), 1-8.*
4. *Graboski MS, McCormick RL. Combustion of fat and vegetable oil derived fuels in diesel engines. Progress in Energy Combustion Science. 1998; 24(2):125–64.*
5. *Sajith, V., Sobhan ,C., B., and Peterson, G.P. Experimental investigations on the effects of ceriumoxide nano particle fuel additives on biodiesel. Advances in Mechanical Engineering, 2010, 2010, 1–6, article ID 581407.*
6. *Correa, I. M. Desempenho de motor diesel com misturas de biodiesel deóleo de girassol. Ciência e Agrotecnologia, Lavras, v.32, n.3, p.923-928, 2008.*
7. *Swaminathan, C., & Sarangan, J. (2012). Performance and exhaust emission characteristics of a CI engine fueled with biodiesel (fish oil) with DEE as additive. biomass and bioenergy, 39, 168-174.*
8. *Barbosa Desempenho comparativo de um motor de ciclo diesel utilizando diesel e misturas de biodiesel. Ciência e*

Agrotecnologia, Lavras, v. 32, n.5, p. 1588-1593, 2008.

9. *Venkatesan. K and Rahul Rao. J, Diesel Engine Performance and Emission analysis using Mosambi peel pyro oil with Nano additive particles, International Journal of Mechanical and Production Research and Development, 2018, vol 8, Issue 6, page 311-316.*